



FINANCIAL FEASIBILITY & AFFORDABILITY

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Students from Weber State University Department of Construction & Building Sciences made up the senior project team representing departments:

- Building Design & Construction
- Interior Design
- Construction Management

Our team constructed the all-electric home they designed, in collaboration with Ogden City, on the corner of 28th street and Quincy Avenue.

The 2,540 total square foot home (1270 on main and 1270 finished basement) incorporates portable battery backup technology to allow the home to maintain critical loads for up to 72 hours if the electrical grid were to be down in a natural disaster or emergency. Not only does the Solar Array generate enough energy to offset the energy usage of the home annually, it also generates enough electricity to charge an electric vehicle to travel 20 miles per day. Occupants are able to monitor their usage via Solar Edge App and Emporia Vue app, helping users understand their energy consumption.



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From the street, other than the solar panels, there is no distinct differentiation that this house is a net positive, all electric home. Capable of producing all of its own energy annually and maintaining all of its critical loads in excess of a week, this home also charges an electric car to drive up to 20 miles per day in the detached garage. This was on purpose! We wanted to prove that you can build a net zero home without it "sticking out" in order to appeal to a broad audience. Average size of single family house along the Wasatch Front is 2200 sq. ft. Our home meets the demands of large families, multi-generational families and potential ADU opportunities.



We designed large overhangs to nearly eliminate solar heat gain in the summer due to shade angles. We maximized the windows on the East side to allow solar heat gain in the winter, but limited the west facing windows and eliminated all windows on the south to minimize solar heat gain during the summer.



The view of the picturesque Rocky Mountains are to the East. All of the living space was intentionally placed on the East side of the home in conjunction with large windows to allow ample daylight and stunning sunrises and sunsets.



The home is long and narrow, therefore long site lines were designed to allow the feeling of a more open floor plan. All upstairs hallways were eliminated to open up the spacious feel of the floor plan and to accommodate for ADA accessibility.

All potential buyers who walked through the home commented on how much bigger it felt than it appeared from the exterior. We knew we were successful when the sub-contractors, who were working on the build, started asking if they could buy the home.

The Materials were selected with affordability in mind. Framing is typically one of the most expensive trades in home construction. By utilizing structurally integrated panel systems (SIPS), we were able to reduce framing labor and material costs by 17% when compared to current market conditions for traditional framing. In addition savings from reduction in materials and labor, SIPS minimize thermal bridging with 6" of polystyrene, high density, foam pressed between two sheets of 1" OSB, increasing a tight building envelope nearly eliminating air leakage.

By selecting insulated concrete forms (ICF's), the team self performed construction of the basement walls saving +\$15,000 in labor/materials. ICF's are a product any homeowner can install with guidance, fitting together like legos with 2" of insulation on each side, reinforced with rebar prior to 8" of concrete fill. ICF's create a R-22 to R-45 insulation value, verses a traditional concrete foundation at R-8, increasing long term energy cost savings.

The plumbing system was designed specifically to minimize the amount of pipe run between usage points. This reduces both material and labor plumbing costs. All fixtures used in the house are Water Sense certified, reducing water waste and energy demand. The water heater utilizes heat pump technology and also acts as a "battery" during the day by utilizing surplus energy produced from the solar panels, storing this extra energy in the hot water.

An all electric HVAC , mini split system was selected for it's multi zone programable designed and variable refrigerant flow (VRF) technology to minimize energy waste by transferring heat from one area to another. Using this HVAC system eliminated the need for a gas utility connection to the property, resulting in an immediate \$4,000 savings and elimination of a future utility bill. An energy recovery ventilator (ERV) was installed to captures energy as air is exhausted from the house. The energy is then transferred to incoming air, reducing the delta needed for fresh air to be conditioned.

The Construction Costs as of August 31, 2020:



\$199,423.42 in donations

\$314,595.46 out of pocket expenses

Donations:

\$108,267.80 ... Gift in Kind
 \$27,854.00 ... Student/Faculty Sweat Equity
 \$43,301.62 ... Ogden City
 \$20,000 ... Wadman Corporation

Click here to see a spreadsheet comparing the original estimate to the actual expenditures as well as the total Gift in Kind breakdown.

Cost per square foot:

2540 finished square feet:

\$135.83 ... cost per SF includes permit & lot fees paid by Ogden City,

Comparables:

Average new build construction costs for Ogden Utah: \$175 per SF.
 Medium list price per SF in Utah (Realtor.com 2/20/21): \$241 per SF.
 Average SOLD price the State of Utah (MLS 2/20/21): \$497,251

True Value:

True value per square foot: \$202.36, including all donations and sweat equity.
 The true value of the Net Zero house was \$514,018.88.

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The Unexpected expenses totaled \$65,984.16. Our actual expenses ended up \$1,388.70 LESS than our original estimate resulting in \$314,595.46 of out of pocket expenses.

Our team came in under budget despite a 20+% increase to estimated costs with unforeseen expenses. Smart construction management allowed this project to gain savings by:

- 1) Initial bid vs actual contracted cost
- 2) Tightening the schedule resulted in a reduction of general conditions costs
- 3) Leveraged subcontractor relationships ensuring quality completion



Thirteen full price offers

were received within the two week window that the house was on the market. A "opportunity drawing" was held where the President of the University drew, at random, the new owners. This home was offered at appraised value, with comparable properties selling or sold at a much higher price.

Many developers and local builders toured the property as it was being built and during the open house phase. One party, in particular, was working with an adjacent city to permit 50+ net zero, single family, homes. Due to the strong economy in Utah, housing prices have increased 24% over last year. Low inventory, high demand and below average mortgage rates are factors effecting the housing market statewide.



This house has the potential to offer affordable building solutions to the growing Utah housing market through immediate and/or long term impacts by efficient build techniques, materials and long term utility savings.

The ability to mass produce this house is high due to its pre-manufactured parts, simple design and off the shelf HVAC and photovoltaic system, positively impacting the US residential energy efficiency efforts and renewable industry sectors.

Our home sold November 13, 2020 at above median sales price for 2020. Comparables in the area indicate this home could have sold for \$173.00 sq. ft. - \$261.00 sq. ft. or:

\$439,420 - \$662,940

Out of pocket expenses to build this home was \$314,595.46.

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UtahRealEstate.com - Column Report - Residential

				
Ref #:	1702345	1706503	1715851	1719172
MLS#:	09/18/2020	10/09/2020	12/08/2020	01/08/2021
Entry Date:	Sold	Sold	Sold	Sold
Status:	no	no	no	no
UnderConst:	\$345,000	\$379,000	\$408,900	\$419,900
List Price:	\$135.83	\$175.46	\$188.78	\$193.24
Price/Sq Ft:	Single Family	Single Family	Single Family	Single Family
Type:	Bungalow/Cottage	2-Story	2-Story	2-Story
Style:	2807	3452	2133	2125
House #:	QUINCY AVE	ECCLES AVE	PORTER AVE	PORTER AVE
Street:				
Unit #:	Ogden	Ogden	Ogden	Ogden
City:	UT, 84403	UT, 84403	UT, 84401	UT, 84401
State/Zip:	OGDEN CITY SURVEY		STONE HILL	STONE HILL
Proj/Subdiv:		SE		
Quadrant:		3452		
North/South:		1050		
East/West:	02-011-0061 • History	05-044-0061 • History	01-117-0004 • History	01-117-0003 • History
Tax ID:	6	4	4	4
Tot Beds:	2.00	3.00	3.00	3.00
Tot Bath:	0	0	0	0
Fireplace:	2	1	1	1
Tot Family:	0	0	0	0
Lev4sqft:	0	0	0	0
Lev3sqft:	0	0	0	0
Lev2sqft:	0	1080	1279	1254
Lev1sqft:	1270	1080	887	919
BsmFt/Fin%:	1270/95	0/-	0/0	0/0
Tot SqFt:	2,540	2,160	2,166	2,173
Gar Port:	2/0	2/0	2/0	2/0
Deck/Patio:	0/0	0/0	0/1	0/1
Exterior:	Clapboard/Masonite	Cement Board, Vinyl	Brick, Clapboard/Masonite; Stone	Brick, Clapboard/Masonite; Stone
Roof:	Asphalt Shingles	Asphalt Shingles	Asphalt Shingles	Asphalt Shingles
Heating:	Electric; Active Solar; >= 95% efficiency	Forced Air, Gas: Central	Forced Air, Gas: Central; Gas: Stove; >= 95% efficiency	Forced Air, Gas: Central; >= 95% efficiency
AirCond:	Central Air, Electric; Active Solar	Central Air, Electric	Central Air, Electric	Central Air, Electric
Water:	Culinary	Culinary; Secondary	Culinary	Culinary
Utilities:	Power: Connected; Sewer: Connected; Water: Connected	Gas: Connected; Power: Connected; Sewer: Connected; Water: Connected	Gas: Connected; Power: Connected; Sewer: Public; Water: Connected	Gas: Connected; Power: Connected; Sewer: Public; Water: Connected
Acres:	0.13	0.18	0.16	0.16
Est. Taxes:	1	683	1,400	1,400
HOA Fee:	\$0	\$0	\$0	\$0
Year Built:	2020	2020	2020	2021
Zoning:	2	2	2	2
CDOM:	24	24	13	7
DOM:	24	24	13	7
Sold Date:	11/13/2020	12/9/2020	1/8/2021	2/10/2021
Sold Price/Sq Ft Inc Lot:	\$135.83	\$173.61	\$188.78	\$193.24
Sold Price:	\$345,000	\$375,000	\$408,900	\$419,900

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State is Utah • Status is Sold or Active • City is Weber County or Ogden • Number of Days Back at most 180 days back
• Property Type is Single Family • Year Built at least 2019 • Total Square Feet at least 2000 • Total Square Feet at most 2800

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Utility Cost Estimate

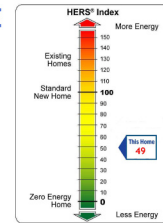
HERS rating notes an annual consumption of 13,180 kWh. however, the photovoltaics installed are not taken into account regarding annual savings.

The actual solar array installed is capable of producing 14,360 kWh annually.

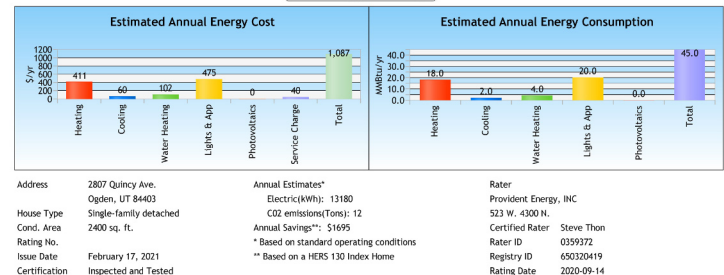
When taking into account the amount of energy produced on site compared to the energy demands of the house (based on standard operation conditions), the house produces MORE energy annually than what is needed for consumption.

Rocky Mountain Power's net metering agreement credits consumers for energy pushed onto the grid. A \$9 a month fee is charged to all users. It is anticipated the electrical bill for this residence will only be \$9 a month.

HERS PERFORMANCE



ENERGY RATING CERTIFICATE



REM/Rate - Residential Energy Analysis and Rating Software v16.0.4
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The Home Energy Rating Standard Disclosure for this home is available from the rating provider.

The house is void of gas utilities by choice, this eliminates future utility bill costs and supports clean air initiatives.

The cost to the users is estimated at \$9 a month. An estimated electric and natural gas savings of \$2892 annually.

Typical Rocky Mountain Power bill for 2400 sq. ft. home is \$150 a month or \$1800 annually.



A net metering agreement with Rocky Mountain Power requires a \$9 a month connection fee, or \$108 annually.



Electrical utility costs savings equates to \$1692 annually or ONE months mortgage.

Eliminating the gas line resulted in monthly estimated savings of \$100 or \$1200 annually.

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30 Year Forecasted Cost Savings

Traditional Home Utility Costs:

If energy prices continue to increase at 1.5% a year, average utility costs for a 2400 sq. ft home, located in Utah, 30 years from now will be:

Year 2050:

\$4,619 annually, or
\$385 a month

Net Meter House Utility Costs:

If energy prices continue to increase at 1.5% a year, average utility costs for a net metering agreement for a 2400 sq. ft home, located in Utah, 30 years from now will be:

\$166 annually, or
\$14 a month

Cost savings total, over 30 years:

\$108,561

